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Effect of diet containing different levels of dried azolla meal on some economic evaluation parameters of broiler chickens.

Eman Hamed Elmelegy¹, and Atallah, S.T², and Eman Ramadan Kamel¹

¹Department of Animal Wealth Development, Faculty of Veterinary Medicine, Benha University, Moshtohor, Toukh 13736, Qalyubia, Egypt.

²Department of Animal Husbandry and Animal Wealth Development, Faculty of Veterinary Medicine, Alexandria University.

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ABSTRACT

This study was conducted to investigate the effect of using different levels of dried Azolla (DA) on some economic evaluation parameters of broiler chickens. A total of 200 healthy unsexed one-day-old broiler chicks (Cobb type) were allocated randomly in to four groups (50 chicks/each group). Each group consists of three replicates. DA was chemically analyzed and used as 0%, 4%, 8% and 12% to formulate 4 balanced experimental diets (Control, T4, T8, and T12, respectively). Results revealed high positive and negative correlation among the different studied productive and economic variables. Total production function among the experimental groups, showed a significant positive effect of the changes in total feed intake (TFI), and feed cost on body weight (BW). Broiler group fed 4% DA revealed a significant positive effect of the changes in TFI, and feed cost on BW. And a significant effect of changes in total cost (TC) on total return (TR).

1. INTRODUCTION

Poultry farming is common practice of raising different types of birds such as geese, ducks, turkeys, chickens. These birds are raised for domestic or commercial purpose for meat, egg and feather production. Chicken meat are beneficial and considered a good source of minerals, vitamins, and protein for human, in the last three decades' poultry industry had made a rapid progress (Rao, 2015). The shortage of world animal protein made nutritionists to discover the possibility of using untraditional feed ingredients in diet formulation of animals to feed growing human population (Rana et al. 2017). Azolla pinanta is one of aquatic floating fern plants and can be used as untraditional high protein source that contain all essential amino acids, minerals such as phosphorus, iron, potassium, magnesium, manganese, calcium and vitamins such as vitamin A, vitamin B12 and beta carotene (Rana et al. 2017). Azolla can be used in form of sundried and ground Azolla meal (Balaji et al. 2009). Azolla has immune stimulating effect due to its high carotene content, also using of Azolla in poultry diet lead to production cost economization and increased net profit (Dhumal et al. 2009). Using of Azolla in ration decrease feed cost (Sujatha et al. 2013). Azolla have symbiotic relationship with the nitrogen-fixing blue-green algae (Rengma et al. 2019). Additionally, using Azolla in

broiler ration led to increase BW gain, feed conversion rate, decrease mortality rate, and reduce broiler production cost, also presence of Azolla in and around poultry farm led to off smell and house fly population and mosquito menace (Mahanthesh et al. 2018). Easy cultivation, higher productivity, and the high nutritive value of Azolla make it the most using unconventional feed stuff (Rana et al. 2017). Therefore, the present study was designed to evaluate the impacts of dietary inclusion of dried Azolla on some economic evaluation parameters in broiler chickens.

2. MATERIAL AND METHODS

The current experiment was approved by the Committee of Animal Care and Welfare, Benha University, Faculty of Veterinary Medicine, Egypt (BUFVTM:01-12-20). The experimental period was extended for 6 weeks from September 24th to November 5th in the year 2020 at the Experimental Animal Research Center, Faculty of Veterinary Medicine, Benha University, Egypt.

2.1. Birds, housing, and management

200-day-old broiler chicks (Cobb) obtained from El-NILE Company for poultry and feeding, Egypt. The average initial weight of chicks was about 43.61 ± 0.15 g/chick. The chicks were individually weighed, wing banded for their

* Corresponding author: emyhamed25@yahoo.com

identification and were allocated randomly in to four groups (50 chicks/each group). Each group consists of three replicates. The chicks were housed in a clean well-ventilated deep litter pens and the floor was covered with wood shaving up to 5 cm height. The house was provided with heaters to adjust the environmental temperature according to the age of chicks. All birds have same managerial, hygienic, and housing conditions including water, food, spacing and lighting. In the first 3 days, the brooding temperature was 33°C, then it was gradually lowered to 28°C by the end of the 2nd week of age, then it was maintained around 28°C till the end of the experimental period, and the relative humidity was between 60-70%, with 23h/d light throughout experimental period. Fresh water and feed were provided ad libitum. The chicks were vaccinated against Newcastle disease, infectious bronchitis disease, influenza virus (H5) and infectious bursal disease.

2.2. Diet, and experimental design

Azolla was collected as green plant from Ahmed Azzam Company for Agricultural Projects Management, Giza Governorate, Egypt. It was sun dried immediately after harvesting, after complete sun drying Azolla was then ground. Dried Azolla (DA) sample was chemically analyzed before being used in the broiler diets. Four iso-energetic and iso-nitrogenous diets were formulated for Cobb chicks following the recommendation by National Research Council (NRC, 1994). The chicks were fed starter diet from day zero till the 10th day of age, after that chicks were fed on grower diet that was given till the 22nd day of age, finally chicks were fed on finisher diet till the end of the experiment (42nd day of age). The experimental diets contained yellow corn, soybean meal (44), corn gluten meal, in addition to mineral and vitamin supplements. The diets were formulated to contain 0%, 4%, 8%, and 12% DA for control, T4, T8, and T12, respectively as presented in Table 1.

2.3. Statistical analysis

Correlation matrix: Pearson's correlation coefficient is a statistical measure of the strength of a linear relationship between paired data, it was estimated among different productive, return and costs parameters to show the degree of correlation between the studied variables to determine the best variables that used for estimation the production and costs functions. The results of correlation coefficient can be classified according to (Ahmed, 2007) in to: (a) Positive correlation which classified into High (over 0.50), Medium (0.34 to 0.50), and Low (0 to 0.33). (b) Negative correlation which classified into High (over -0.50), Medium (-0.34 to -0.50), and Low (0 to -0.33).

The production and costs functions were carried out to assess the effect of changes in TFI and feed costs on BW, and the effect of changes in costs parameters on returns of broiler chickens for each experimental group, and within all groups according to Atallah (1997), by using the computer programs SPSS/PC+ "version 23"(SPSS, 2015). Application of the production and cost functions was done in two forms

logarithmic and linear one. The logarithmic form was the best form which described the studied variables. The function was made according to the methods implied by El-Tahawey (2004) and Sara (2007). Choosing the best function of either production or costs was done according to the acceptance of the function economically, statistically (significance of F test, t – test as well as value of adjusted coefficient of determination R²) and the reality of its results to broiler production (Wonnacott and Wonnacott, 1981 and Atallah 1994 and 1997). We use adjusted regression coefficient R² as the number of independent variables increased, so the value of the regression coefficient increased and it will lose its significant, so we use the adjusted regression coefficient:

$$R^2 = \frac{1 - S^2_e}{S^2_y} = 1 - \frac{ESS / (n - k - 1)}{TSS / (n - 1)}$$

$$RSS = b_1 \sum X_{1y} + b_2 \sum X_{2y}$$

$$ESS = TSS - RSS$$

$$R^2 = RSS / TSS$$

3. RESULTS

3.1. Correlation matrix among the values of final BW, TFI, final BWG, final feed conversion rate (Final FCR), TC, TR, Net profit (NP), and total variable cost (TVC) for the experimental groups.

Results in Table (2) showed high positive correlation among Final BWG, Final BW (1.00); Final FCR, TFI (0.939); TC, TFI (0.999); TC, Final FCR (0.942); TR, Final BW. (1.00); TR, Final BWG (1.00); NP, Final BW (0.921); NP, Final BWG (0.920); NP, TR (0.917); TVC, TFI (0.999); TVC, Final FCR (0.947); TVC, TC (0.999). While high negative correlation was found among TFI, Final BW (-0.536); Final BWG, TFI (-0.535); Final FCR, Final BW (-0.792); Final FCR, Final BWG (-0.792); TC, Final BW (-0.549); TC, Final BWG (-0.548); TR, TFI (-0.529); TR, Final FCR (-0.787); TC, TR (-0.542); NP, TFI (-0.822); NP, Final FCR (-0.966); NP, TC (-0.831); TVC, Final BW (-0.559); TVC, Final BWG (-0.559); TVC, TR (-0.552); TVC, NP (-0.838)

3.2. Effect of TFI on BW.

Results in table (3) illustrated a significant ($P \leq 0.01$) total production function among the experimental groups, showing a significant effect of the changes in TFI on BW. As shown in tables (4 -7), there was a negative relationship between final BW and TFI for broiler chickens in all experimental groups except for group fed 4% DA which was a positive relationship.

3.3. Effect of feed cost on BW.

Results in table (3) indicated a significant ($P \leq 0.01$) effect of changes in feed cost on BW among the experimental groups. Tables (4-7) showed a negative relationship between final BW and feed cost for broiler chickens in all groups except for group fed 4% DA, showed a positive relationship.

3.4. Effect of TC on TR.

Results in table (3) showed a significant ($P \leq 0.01$) effect of changes in TC on TR among the experimental groups.

Concerning tables (4-7), there was a negative relationship between TR and TC for broiler chickens in all groups except for group fed 4% DA there were a positive relationship.

Table 1. Ingredients Composition and calculated chemical analysis of the experimental diets.

Feed ingredients (g / kg as fed)	Starter				Grower				Finisher			
	Control	T1	T2	T3	Control	T1	T2	T3	Control	T1	T2	T3
Azolla ¹	0.0	40.00	80.00	120.00	0.0	40.0	80.0	120.0	0.0	40.0	80.0	120.0
Yellow corn	588.0	578.0	548.0	546.0	625.0	603.0	580.0	554.0	665.0	647.0	646.0	618.0
SBM ²	185.0	197.0	187.0	132.0	156.0	145.0	122.0	110.0	97.0	78.0	79.0	64.0
Corn gluten meal	140.0	126.0	123.0	149.0	122.0	120.0	125.0	124.0	142.0	145.0	138.0	137.0
Wheat bran	29.0	0.0	0.0	0.0	32.0	25.0	26.0	22.0	34.0	29.0	0.0	0.0
Soybean oil	14.0	15.0	19.0	11.0	24.0	26.0	27.0	30.0	23.0	23.0	20.0	24.0
L-lysine	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
DL-Methionine	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Vit. & Min. mix. ³	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Salt	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Limestone DCP ⁴	15.0	15.0	14.0	13.0	14.0	14.0	13.0	13.0	14.0	13.0	12.0	12.0
Total	15.0	15.0	15.0	15.0	13.0	13.0	13.0	13.0	11.0	11.0	11.0	11.0
Calculated chemical composition (%) ⁵												
CP	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0
CF	21.99	22.0	22.1	22.1	20.0	20.0	20.02	20.03	19.0	19.0	19.04	19.0
Ca	3.41	3.72	4.16	4.42	03.29	3.67	4.06	4.46	3.05	3.41	3.69	4.1
Available P	0.96	0.98	0.97	0.95	0.87	0.89	0.88	0.90	0.81	0.80	0.79	0.80
Lysine	0.47	0.47	0.47	0.47	0.43	0.43	0.44	0.44	0.38	0.39	0.38	0.38
Methionine	1.35	1.4	1.4	1.32	1.27	1.27	1.25	1.25	1.14	1.12	1.14	1.14
Sodium	0.56	0.55	0.55	0.57	0.52	0.52	0.52	0.52	0.52	0.53	0.52	0.52
ME (kcal/kg)	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
	3035.7	3037.5	3035.3	3037.9	3110.4	3109.1	3108.5	3108.3	3181.0	3180.9	3182.1	3182.8

¹Azolla: crude protein = 22.48%, crude fiber% = 14.7, fat = 4.5%, ash = 17.34%, metabolizable energy = 2458.4 kcal/kg, ²Soybean meal (44% crude protein). ³Hy-Mix commercial broiler premix purchased by Misr feed additives company, Egypt. Composition (per 3kg): Vitamin A = 12,000,000 IU, D₃ = 4,000,000 IU, E = 60,000 mg, K₃ = 3,000 mg, B₁ = 2,000 mg, B₂ = 6,500 mg, B₆ = 5,000 mg, B₁₂ = 20 mg, Niacin = 45,000 mg, Biotin = 75 mg, Folic acid = 2,000 mg, Pantothenic acid = 12,000 mg, Choline chloride = 1000,000 mg, Zinc = 80,000 mg, Manganese = 100,000 mg, Iron = 45,000 mg, Copper = 10,000 mg, Iodine = 1,000 mg, Selenium = 200 mg, Cobalt = 100 mg, Calcium carbonate to 3kg. ⁴Dicalcium phosphate (21% calcium and 20% phosphorus). ⁵According to Feed Composition Tables for broiler chickens (NRC for poultry 1994). Control: 0% dried Azolla, T1: 4% dried Azolla, T2: 8% dried Azolla, T3: 12% dried Azolla.

Table (2): Simple correlation matrix among the values of final BW, TFI, final BWG, final FCR, TC, TR, NP, and TVC for the experimental groups.

	Final BW	TFI	Final BWG	Final FCR	TC	TR	NP	TVC
Final BW	1							
TFI	-0.536	1						
Final BWG	1.0**	-0.535	1					
Final FCR	-0.792**	0.939**	-0.792**	1				
TC	1.0**	-0.529-	1.0**	-0.787**	1			
TR	0.921**	-0.822**	0.920**	-0.966**	0.917**	1		
NP	-0.549	0.999**	-0.548	0.942**	-0.542	-0.831**	1	
TVC	-0.559	0.999**	-0.559	0.947**	-0.552	-0.838**	0.999**	1

** Correlation is highly significant at ($P \leq 0.01$).

Table (3) Total production and cost functions for the experimental groups

Parameters	Logarithmic Function	F	R ²
Production function of BW and TFI	Log weight = 7.66 + 3.50 Log TFI t. (4.25)** (4.17)**	4.26**	0.77
Production function of BW and feed cost	Log weight = 5.38 + 1.48 Log feed cost t. (5.49)** (6.19)*	10.45**	0.77
Cost function of TR and TC	Log TR = 5.99 + 3.70 Log TC t. (4.26)** (4.85)**	15.44**	0.74

** Significant at ($P \leq 0.01$)

Table (4) Production and cost functions for control group.

Parameters	Logarithmic Function	F	R ²
Production function of BW and TFI	Log weight = 8.663 - 1.504 Log TFI t. (4.24)** (4.15)**	4.25**	0.22
Production function of BW and feed cost	Log weight = 5.27 - 1.47 Log feed cost t. (3.44)** (3.81)**	3.28**	0.53
Cost function of TR and TC	Log TR = 5.98 - 2.70 Log TC t. (4.24)** (4.83)**	3.34**	0.54

** Significant at ($P \leq 0.01$)

Table (5) Production and cost functions for 4% DA group.

Parameters	Logarithmic Function	F	R ²
Production function of BW and TFI	Log weight = 2.59 + 0.21 Log TFI t. (5.24)** (4.704)**	22.12**	0.91
Production function of BW and feed cost	Log weight = 3.042 + 0.238 Log feed cost t. (10.26)** (15.57)**	242.41**	0.99
Cost function of TR and TC	Log TR = 0.84 + 0.54 Log TC t. (4.78)**	(5.57)** 24.55**	0.78

** Significant at ($P \leq 0.01$)

Table (6) Production and cost functions for 8% DA group.

Parameters	Logarithmic Function		F	R ²
Production function of BW and TFI	Log weight = 3.712 - 0.10 Log TFI (7.28)** (6.25)**	t.	12.14**	0.47
Production function of BW and feed cost	Log weight = 3.47 - 0.10 (Log feed cost) (4.55)** (5.24)**	t.	7.28**	0.50**
Cost function of TR and TC	Log TR = 2.010 - 0.207 (Log TC) (6.25)** (5.39)**	t.	7.97**	0.32

** Significant at ($P \leq 0.01$)

Table (7) Production and cost functions for 12% DA group.

Parameters	Logarithmic Function		F	R ²
Production function of BW and TFI	Log weight = 3.760 - 0.11 Log TFI (6.24)** (5.33)**	t.	10.17**	0.45
Production function of BW and feed cost	Log weight = 3.51 - 0.19 Log feed cost (5.27)** (4.28)**	t.	10.28**	0.40
Cost function of TR and TC	Log TR = 2.04 - 0.21 Log TC (6.44)** (5.22)**	t.	15.44**	0.43

** Significant at ($P \leq 0.01$)

4. DISCUSSION

Concerning correlation matrix of different productive and economic variables among the experimental groups. Results illustrated high positive and negative correlation among the values of final BW, TFI, final BWG, Final FCR, TC, TR, Net profit (NP), and total variable cost (TVC). This result agreed with Atallah (1997), and Sara (2007) who reported that the correlation matrix was classified into Low positive, Medium positive, High positive, Low negative, Medium negative and High negative among different experimental groups.

Results revealed a significant total production and cost functions for the experimental groups. There was a significant effect of the changes in TFI on BW. About 77% from the changes in BW were attributed to the changes in the TFI. The increasing in the TFI by about 1% results in increasing the broiler BW by about 3.50%. This result may be attributed to the rich nutrient contents in Azolla, particularly protein, vitamins, and minerals (Pillai et al. 2002). These findings agreed with Rawat et al. (2015) who said that the broiler chickens that supplemented with 5% Azolla enhance BWG and feed consumption, and Tarigan and Manalu (2019) who found that Azolla supplementation led to significant effect on chicken feed consumption and BW.

Also, a significant effect of changes in feed cost on BW was indicated among the experimental groups, and about 77% from the changes in BW were attributed to the changes in the feed cost. Increasing the feed cost by about 1% led to increase BW by about 1.48%. These results agreed with those of Shahir et al. (2014) who reported that 70% from the changes of chick's BW supplemented with feed additive were attributed to the changes in feed cost.

Concerning TC effect on TR, about 74% from the changes in TR were attributed to the changes in the TC, the increasing in TC by about 1% led to increase TR by about 3.70%. This result was in accordance with Shehata et al. (2018) who found a significant effect of TC on TR in different dietary supplemented groups.

Referring to the results of the production and cost functions for the control group, about 22% from the changes in BW were attributed to the change in the TFI. The increasing in the TFI by about 1% results in decrease BW by about 1.504%. Concerning the effect of feed cost, results showed that 53% from the changes in BW were attributed to the changes in feed cost. Increasing feed cost by about 1% led to decrease BW by about 1.47%. Concerning the effect of TC on TR in the control group, 54% from the changes in TR were attributed to the changes in the TC. Increasing TC by about 1% results in decrease TR by about 2.70%. These results agreed with the finding of Mahanthesh et al. (2018) who reported that control group had highest feed cost and lowest BWG. Dhumal et al. (2009) mentioned that the chicks fed Azolla have higher BW, and the feed cost per kg of live bird weight is significantly ($P < 0.01$) lower than the control group.

Results of the production and cost functions for broiler group fed 4% DA revealed a significant positive effect of TFI and feed cost on BW, about 91% from the changes in BW were attributed to the changes in the TFI. Increasing TFI by about 1% led to increase BW by about 0.21%. These findings agreed with Kumar et al. (2018) who stated that the broiler chickens that fed 7.5% Azolla showed highest BWG. Additionally, about 99% from the changes in BW were attributed to the changes in the feed cost. Increasing feed cost by about 1% results in increase BW by about 0.238%.

These results were in consistence with Wuthijaree et al. (2012) who recorded that supplementation of Azolla in the diet at rate of 5 to 20% has a significant ($p < 0.05$) effect on feed intake and feed cost.

Concerning the cost function and the effect of TC on TR in the group fed 4% DA. 78% from the changes in TR were attributed to the changes in the TC. Increasing TC by about 1% led to increase TR by about 0.54%. This result agreed with Perić et al. (2011) who found a significant effect of TC on TR.

Results of the production and cost functions for broiler group fed 8% DA showed a significant effect of TFI and feed cost on BW, and about 47% from the changes in BW were attributed to the changes in the TFI. Increasing TFI by about 1% resulted in decreasing BW by about 0.10%. These results were in agreement with Willems et al. (2013) who found a significant relationship between feed intake and BW of broiler chicken. About 50% from the changes in BW were attributed to the changes in the feed cost. As, increasing feed cost by about 1% results in decrease BW by about 0.10%. These results agreed with the finding of Naghshi et al. (2014) who stated that 5% Azolla led to a significant effect on feed cost and BW gain. Concerning the cost function and the effect of TC on TR in the group fed 8% DA, about 32% from the changes in TR were attributed to the changes in the TC. Increasing TC by about 1% will decrease TR by about 0.207%.

Results of the production and cost functions for broiler group fed 12% DA showed a significant effect of TFI and feed cost on BW, about 45% from the changes in BW were attributed to the changes in the TFI. Increasing TFI by about 1% led to decrease BW by about 0.11%. These findings agreed with Wuthijaree et al. (2012) who recorded that supplementation of Azolla in the diet at rate of 5 to 20% has a significant effect ($p < 0.05$) on feed intake and average daily gain. Additionally, 40% from the changes in BW were attributed to the changes in feed cost, as increasing feed cost by about 1% results in decreasing BW by about 0.19%. These findings agreed with Mishra et al. (2016) who mentioned that the birds that fed 10% Azolla have lowest feed cost and have higher BW than control. Concerning the cost function and the effect of TC on TR in the group fed 12% DA, about 43% from the changes in TR were attributed to the changes in the TC. Increasing TC by about 1% results in decreasing TR by about 0.21%. These results agreed with Shehata et al. (2018) who reported a significant effect of TC on TR on different dietary supplemented groups.

5. CONCLUSION

From the current study, we concluded that DA is natural feed additive of low price and plays an important role in reduction of feed cost of poultry farms. About 77% from the changes in broiler BW were attributed to the changes in the TFI and feed cost. Results of the production and cost functions for broiler group fed 4% DA revealed a significant positive effect of TFI and feed cost on BW, and a significant positive effect of TC on TR.

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